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(54) Muffler assembly for engine.

(57) A muffler assembly for an engine comprises an outer cylinder (2) constituting a muffler body, an inner cylinder (4) coaxially disposed in the outer cylinder (2), a connection cylinder (5) disposed inside the inner cylinder (4) having one end on an upstream side and another end on a downstream side, a partition plate (7) disposed inside the inner cylinder (4) at a downstream side end of the connection cylinder (5), first (9) and second (10) silencer chambers formed on an upstream side of the one end of the connection cylinder (5) and on a downstream side of the another end of the connection cylinder (5), an inlet pipe (12) through which an engine exhaust gas is introduced into the muffler body, and an outlet pipe (18) having an upstream end disposed inside the inner cylinder (4) and a

downstream end opened outward of the muffler assembly. The connection cylinder (5) has an upstream end portion to which a plurality of holes (15) are circumferentially formed. The inlet pipe (12) has a downstream side end portion to which a plurality of holes (14) are circumferentially formed so as to flow the exhaust gas passing through the inlet pipe (12) is introduced into the first silencer chamber (9). The upstream end of the outlet pipe (18) is plugged (20) and coaxially inserted into the downstream end of the connection cylinder (5), the outlet pipe (18) having an upstream end portion to which a plurality of holes (21) are formed. An resonance chamber (24) is formed so as to surround the outlet pipe (18) at the downstream portion thereof.

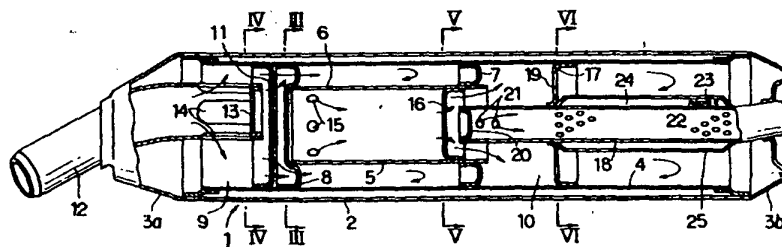


FIG. 2

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## BACKGROUND OF THE INVENTION

The present invention relates to a muffler assembly for an engine unit of a motorcycle, for example, for achieving an improved performance of the muffler assembly.

In general, an engine unit mounted to a motorcycle, for example, is provided with an engine exhaust gas port connected to an exhaust pipe, which is then connected at its rear end to a muffler for discharging the exhaust gas after silencing noise of the exhaust gas in the muffler.

Generally, a muffler device is classified into three types, i.e. expansion type, resonance type and reverse type on the basis of the flow of the exhaust gas in the muffler device. In actual, the muffler device is constructed in combination of these types as occasion demands.

In order to achieve an improved silencing effect, reduce a back pressure and reduce an output loss, it is necessary for the muffler to have an increased inner volume and an elongated length.

However, for the motorcycle, a cylindrical muffler is disposed at a side of a rear portion of the motorcycle body, and in this meaning, the volume and the length of the muffler are inevitably limited due to the length or size of the motorcycle body, the layout thereof and the location of other equipments for the motorcycle.

On the contrary, in order to construct a muffler device having an excellent silencing effect with small volume, the structure of the muffler device is inevitably made complicated.

Particularly, with respect to the motorcycles, various requirements in operations or performances including the silencing performance of the muffler device are different in accordance with running places, using countries and so on of the motorcycle. In order to satisfy these different requirements, in a prior art technology, the muffler devices are manufactured by changing sizes, lengths and the like of connection pipes, outlet pipes and other elements for the muffler devices, resulting in complicated and increased manufacturing processes as well as increasing manufacturing cost. Moreover, these also involve troublesome control and management of the manufacture.

## SUMMARY OF THE INVENTION

An object of the present invention is to substantially eliminate defects or drawbacks encountered in the prior art and to provide a muffler assembly for a motorcycle having a reduced volume and length and capable of achieving a highly improved silencing performance, a reduced back pressure and a reduced output loss.

This and other object can be achieved in various

aspects by providing a muffler assembly for an engine of a motorcycle, for example, comprises an outer cylinder constituting a muffler body, an inner cylinder coaxially disposed in the outer cylinder, a connection cylinder disposed inside the inner cylinder having one end on an upstream side and another end on a downstream side, a partition plate disposed inside the inner cylinder at a downstream side end of the connection cylinder, first and second silencer chambers formed on an upstream side of the one end of the connection cylinder and on a downstream side of the another end of the connection cylinder, an inlet pipe through which an engine exhaust gas is introduced into the muffler body, and an outlet pipe having an upstream end disposed inside the inner cylinder and a downstream end opened outward of the muffler assembly. The connection cylinder has an upstream end portion to which a plurality of holes are circumferentially formed. The inlet pipe has a downstream side end portion to which a plurality of holes are circumferentially formed so as to flow the exhaust gas passing through the inlet pipe is introduced into the first silencer chamber. The upstream end of the outlet pipe is plugged and coaxially inserted into the downstream end of the connection cylinder, the outlet pipe having an upstream end portion to which a plurality of holes are formed.

In preferred embodiments, a first punched plate to which a plurality of punched holes are formed is disposed in the muffler body between the one end of the connection cylinder member and the upstream end of the inlet pipe, and a second punched plate to which a plurality of punched holes are formed is disposed in another end portion of the connection cylinder member.

A cylinder member is further arranged coaxially so as to surround a downstream side portion of the outlet pipe with a space as a resonance chamber between the cylinder member and the outer peripheral surface of the outlet pipe and wherein a plurality of perforations are formed to the outer peripheral surface of the outlet pipe at portions corresponding to a location of said resonance chamber and a sound absorption material fills the resonance chamber.

A support plate is further disposed inside the inner cylinder member at a portion directly in front of one end of the connection cylinder member, the support plate having an outer peripheral portion to which a plurality of holes are formed and a central solid portion having a size sufficient for closing the one end of the connection cylinder member.

According to the present invention of the characters described above, the engine exhaust gas is introduced circumferentially into the first silencer chamber from the downstream end of the inlet

pipe, the back pressure of the exhaust gas can be reduced even if the downstream end of the inlet pipe is disposed near the connection cylinder, thus reducing the whole length of the muffler assembly, and the exhaust gas can be effectively diffused, thus enhancing the silencing effect.

The upstream end of the outlet pipe is inserted into the downstream end of the connection cylinder, so that the relatively long outlet pipe can be arranged without extending the muffler assembly, thus effectively attenuating pressure pulsation of the exhaust gas. The location of the resonance chamber improves the silencing efficiency.

In the embodiment in which the connection cylinder is provided with a plurality of holes, the exhaust gas once expanded in the first silencer chamber is throttled when passing the holes and then expanded in the second silencer chamber. The exhaust gas is again throttled when passing the holes formed to the outlet pipe. The sizes of these holes can be selectively easily changed by the drilling working, thus being adapted for various requirement for the muffler performance.

#### BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the present invention and to show how the same is carried out, reference is first made, by way of preferred embodiments, to the accompanying drawings, in which:

Fig. 1 is a general outer appearance of a muffler assembly according to the present invention;

Fig. 2 is a longitudinal sectional view of the muffler assembly of Fig. 1; and

Figs. 3 to 6 show sectional views taken along the line III-III, IV-IV, V-V and VI-VI shown in Fig. 2 for showing inside arrangements of various sections of the muffler assembly of the present invention.

#### DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 1 shows an outer appearance of a muffler assembly according to the present invention and Fig. 2 is a longitudinal sectional view thereof. Referring to Fig. 2, the muffler assembly 1 comprises an outer cylinder 2 as a muffler body and an inner cylinder 4 disposed substantially coaxially inside the outer cylinder 2 with a space therebetween. The location of the space is for the purpose of reducing outward radiation of impact or shock noise due to pressure pulsation caused by an exhaust gas from the engine through an exhaust pipe. End plates 3a and 3b are disposed front and rear ends of the outer cylinder 2.

In the interior of the inner cylinder 4, is co-

axially disposed a connection cylinder 5 at substantially the central portion therein, which is supported by a support plate 6 at its front end and a partition plate 7 at its rear end. These support plate 6 and the partition plate 7 are secured to the inner surface of the inner cylinder 4 by a suitable manner such as welding means.

As shown in Fig. 3, the support plate 6 has generally a circular configuration and a plurality of windows 8, four in the illustration, are formed to the outer peripheral portion of the support plate 6 and a central portion is positioned to close the front end of the connection cylinder 5. The support plate 6 has a shape as shown in Fig. 2 as a side sectional view suitable for closing and supporting the front end of the connection cylinder 5.

The partition plate 7 has also a circular configuration as shown in cross section in Fig. 2 and has a central hole through which the rear end of the connection cylinder 5 extends in a supported manner. Thus the partition plate 7 also supports the connection cylinder 5. The interior of the muffler body is sectioned into first and second silencer chambers 9 and 10 by the support plate 6 and the partition plate 7, the first silencer chamber 9 being in the front, upstream, side of the support plate 6 and the second silencer chamber 10 being in the rear, downstream, side of the partition plate 7.

As shown in Figs. 2 and 3, a punched plate 11 is disposed in the first silencer chamber 9 directly in front of the support plate 6 and the punched plate 11 is provided with a plurality of holes 11a for facilitating the diffusion of the exhaust gas from the exhaust pipe in the muffler body. An inlet pipe 12 connected to the exhaust pipe is inserted into the front end of the muffler body so that the inserted end of the inlet pipe 12 is disposed in the first silencer chamber 9 near the punched plate 11. The inserted open end of the inlet pipe 12 is closed by a plugging plate 13 and a plurality of holes 14 each in shape of longitudinal slit are circumferentially formed to the outer peripheral surface, near the inserted end, of the inlet pipe 12, through which the exhaust gas flows circumferentially as shown by arrows in an expanded manner.

A plurality of holes each in shape of longitudinal slit, for example, are formed to the outer peripheral surface, near the support plate 6, of the connection cylinder 5. The opened rear end of the connection cylinder 5 is closed by a punched plate 16 provided with a plurality of small holes 16a. As shown in Fig. 2, the punched plate 16 is inserted into the opened rear end of the connection cylinder 5 and secured thereto in an arrangement shown in Fig. 5.

In the second silencer chamber 10, is located an outlet pipe 18 which is supported thereon by a support plate 17 and the end plate 3b. As shown in

Fig. 6, the support plate 17 is provided with a plurality of, three in the illustration, large windows 19 so as not to block the flowing of the exhaust gas in the second silencer chamber 10 and also provided with a central hole through which the outlet pipe 18 extends in a supported manner. The front end of the outlet pipe 18 extends coaxially in the rear end of the connection cylinder 5 near the punched plate 16 and closed by a plugging plate 20. A plurality of holes 21 are formed to the front end portion of the outlet pipe 18. A number of small holes, perforations, 22 are formed to the outer peripheral surface of the outlet pipe 18. In the illustrated embodiment, a cylindrical member 25 is coaxially disposed around the outer peripheral surface of the rear side portion of the outlet pipe 18 so as to form a space between the cylindrical member 25 and the outlet pipe 18 as a resonance chamber 24 which is filled with a sound absorption material such as glass wool 23. The location of the perforations 22 may substantially correspond to the location of the resonance chamber 24. The rear end of the outlet pipe 18 is tightly supported by the end plate 3b so that the extreme end of the outlet pipe 18 extends outward of the muffler assembly 1.

The respective holes of the connection cylinder 5 and the outlet pipe 18 are easily formed by a drilling working and the holes of the punched plates 11 and 16 are also formed easily by a punching working.

According to the muffler assembly of the structure described above, the exhaust gas introduced into the inlet pipe 12 through the exhaust pipe connected to the engine exhaust port is discharged into the first silencer chamber 9 through the holes 14 formed to the rear end portion of the inlet pipe and then expanded and silenced therein. The exhaust gas then flows downwardly and is diffused through the holes 11a of the punched plate 11 as shown by arrows. The exhaust gas is thereafter introduced into the connection cylinder 5 through the holes 15 formed to the front end portion thereof and then further diffused into the second silencer chamber 10 through the holes 16a of the punched plate 16 at the rear end portion of the connection cylinder 5, thus being expanded and silenced in the second silencer chamber 10. The expanded exhaust gas is introduced into the outlet pipe 18 through the holes 21 formed to the front end portion thereof and exhausted outward of the muffler assembly 1 through the rear end of the outlet pipe 18 while being subjected to the resonance sound absorption in the resonance chamber 24.

As can be understood from the foregoing, according to the muffler assembly of the present invention, various types of flows of the exhaust gas can be accomplished as shown by arrows in Fig. 2.

According to the present invention, as de-

scribed above, the muffler assembly has a small volume and a short longitudinal length while maintaining the improved silencing efficiency, and the throttling efficiency for the exhaust gas can be optimally changed by changing diameters and numbers of the holes of the connection cylinder and the outlet pipe, for example, and the muffler performance can thus be easily adapted for the requirement in various places or countries at which a motorcycle is utilized.

In another aspect, since the rear end of the outlet pipe is inserted into the rear end portion of the connection cylinder, the whole longitudinal length of the outlet pipe can be made long in spite of the relatively short length of the muffler assembly. In this arrangement, the resonance chamber is also formed to thereby effectively attain the silencing effect and to reduce the back pressure and the output loss.

In a further aspect, since the exhaust gas can be diffused circumferentially into the first silencer chamber through the holes formed to the rear end portion of the inlet pipe, the back pressure can be effectively reduced, thus attaining the improved silencing effect.

It is to be understood that the present invention is not limited to the described embodiments and many other changes and modifications may be made without departing from the scope of the appended claims.

#### Claims

1. A muffler assembly for an engine comprising:
  - an outer cylinder member constituting a muffler body;
  - an inner cylinder member coaxially disposed in the outer cylinder member with a space therebetween;
  - a connection cylinder member disposed inside the inner cylinder member having one end on an upstream side and another end on a downstream side;
  - a partition plate disposed inside the inner cylinder member at a downstream side end of the connection cylinder member;
  - a first silencer chamber formed on an upstream side of the one end of the connection cylinder member;
  - a second silencer chamber formed on a downstream side of the another end of the connection cylinder member;
  - an inlet pipe through which an engine exhaust gas is introduced into the muffler body, said inlet pipe having a downstream end plugged and positioned near the one end of the connection cylinder member, said inlet pipe having a downstream side end portion to

which a plurality of holes are formed in a circumferential arrangement so as to flow the exhaust gas passing through the inlet pipe is circumferentially introduced into the first silencer chamber; and

an outlet pipe having an upstream end disposed inside the inner cylinder member and a downstream end opened outward of the muffler assembly.

2. A muffler assembly according to claim 1, wherein a first punched plate to which a plurality of punched holes are formed is disposed in the muffler body between the one end of the connection cylinder member and the upstream end of the inlet pipe.

3. A muffler assembly according to claim 2, wherein a second punched plate to which a plurality of punched holes are formed is disposed in another end portion of the connection cylinder member.

4. A muffler assembly for an engine comprising:  
an outer cylinder member constituting a muffler body;

an inner cylinder member coaxially disposed in the outer cylinder member with a space therebetween;

a connection cylinder member disposed inside the inner cylinder member having one end on an upstream side and another end on a downstream side;

a partition plate disposed inside the inner cylinder member at a downstream side end of the connection cylinder member;

a first silencer chamber formed on an upstream side of the one end of the connection cylinder member;

a second silencer chamber formed on a downstream side of the another end of the connection cylinder member;—

an inlet pipe through which an engine exhaust gas is introduced into the muffler body; and

an outlet pipe having an upstream end disposed inside the inner cylinder member and a downstream end opened outward of the muffler assembly, said upstream end of the outlet pipe being plugged and coaxially inserted into the downstream end of the connection cylinder member, said outlet pipe having an upstream end portion to which a plurality of holes are formed.

5. A muffler assembly according to claim 4, wherein a cylinder member is further arranged coaxially so as to surround a downstream side

portion of said outlet pipe with a space as a resonance chamber between the cylinder member and the outer peripheral surface of the outlet pipe and wherein a plurality of perforations are formed to the outer peripheral surface of the outlet pipe at portions corresponding to a location of said resonance chamber.

6. A muffler assembly according to claim 5, wherein a sound absorption material fills the resonance chamber.

7. A muffler assembly according to claim 6, wherein the sound absorption material is a glass wool.

8. A muffler assembly for an engine comprising:  
an outer cylinder member constituting a muffler body;

an inner cylinder member coaxially disposed in the outer cylinder member with a space therebetween;

a connection cylinder member disposed inside the inner cylinder member having one end on an upstream side and another end on a downstream side, said connection cylinder member having an upstream end portion to which a plurality of holes are circumferentially formed;

a partition plate disposed inside the inner cylinder member at a downstream side end of the connection cylinder member;

a first silencer chamber formed on an upstream side of the one end of the connection cylinder member;

a second silencer chamber formed on a downstream side of the another end of the connection cylinder member;

an inlet pipe through which an engine exhaust gas is introduced into the muffler body; and

an outlet pipe having an upstream end disposed inside the inner cylinder member and a downstream end opened outward of the muffler assembly, said upstream end of the outlet pipe being plugged, said outlet pipe having an upstream end portion to which a plurality of holes are formed.

9. A muffler assembly according to claim 8, wherein a support plate is further disposed inside the inner cylinder member at a portion directly in front of one end of the connection cylinder member, said support plate having an outer peripheral portion to which a plurality of holes are formed and a central solid portion having a size sufficient for closing the one end

of the connection cylinder member.

**10. A muffler assembly for an engine comprising:**

an outer cylinder member constituting a muffler body;

an inner cylinder member coaxially disposed in the outer cylinder member with a space therebetween;

a connection cylinder member disposed inside the inner cylinder member having one end on an upstream side and another end on a downstream side, said connection cylinder member having an upstream end portion to which a plurality of holes are circumferentially formed;

a partition plate disposed inside the inner cylinder member at a downstream side end of the connection cylinder member;

a first silencer chamber formed on an upstream side of the one end of the connection cylinder member;

a second silencer chamber formed on a downstream side of the another end of the connection cylinder member;

an inlet pipe through which an engine exhaust gas is introduced into the muffler body, said inlet pipe having a downstream end plugged and positioned near the one end of the connection cylinder member, said inlet pipe having a downstream side end portion to which a plurality of holes are formed in a circumferential arrangement so as to flow the exhaust gas passing through the inlet pipe is circumferentially introduced into the first silencer chamber; and

an outlet pipe having an upstream end disposed inside the inner cylinder member and a downstream end opened outward of the muffler assembly, said upstream end of the outlet pipe being plugged and coaxially inserted into the downstream end of the connection cylinder member, said outlet pipe having an upstream end portion to which a plurality of holes are formed.

**11. A muffler assembly according to claim 10, wherein a first punched plate to which a plurality of punched holes are formed is disposed in the muffler body between the one end of the connection cylinder member and the upstream end of the inlet pipe.**

**12. A muffler assembly according to claim 11, wherein a second punched plate to which a plurality of punched holes are formed is disposed in another end portion of the connection cylinder member.**

**13. A muffler assembly according to one of the claims 10-12, wherein a cylinder member is further arranged coaxially so as to surround a downstream side portion of said outlet pipe with a space as a resonance chamber between the cylinder member and the outer peripheral surface of the outlet pipe and wherein a plurality of perforations are formed to the outer peripheral surface of the outlet pipe at portions corresponding to a location of said resonance chamber.**

**14. A muffler assembly according to claim 13, wherein a sound absorption material fills the resonance chamber.**

**15. A muffler assembly according to one of the claims 10-14, wherein a support plate is further disposed inside the inner cylinder member at a portion directly in front of one end of the connection cylinder member, said support plate having an outer peripheral portion to which a plurality of holes are formed and a central solid portion having a size sufficient for closing the one end of the connection cylinder member.**

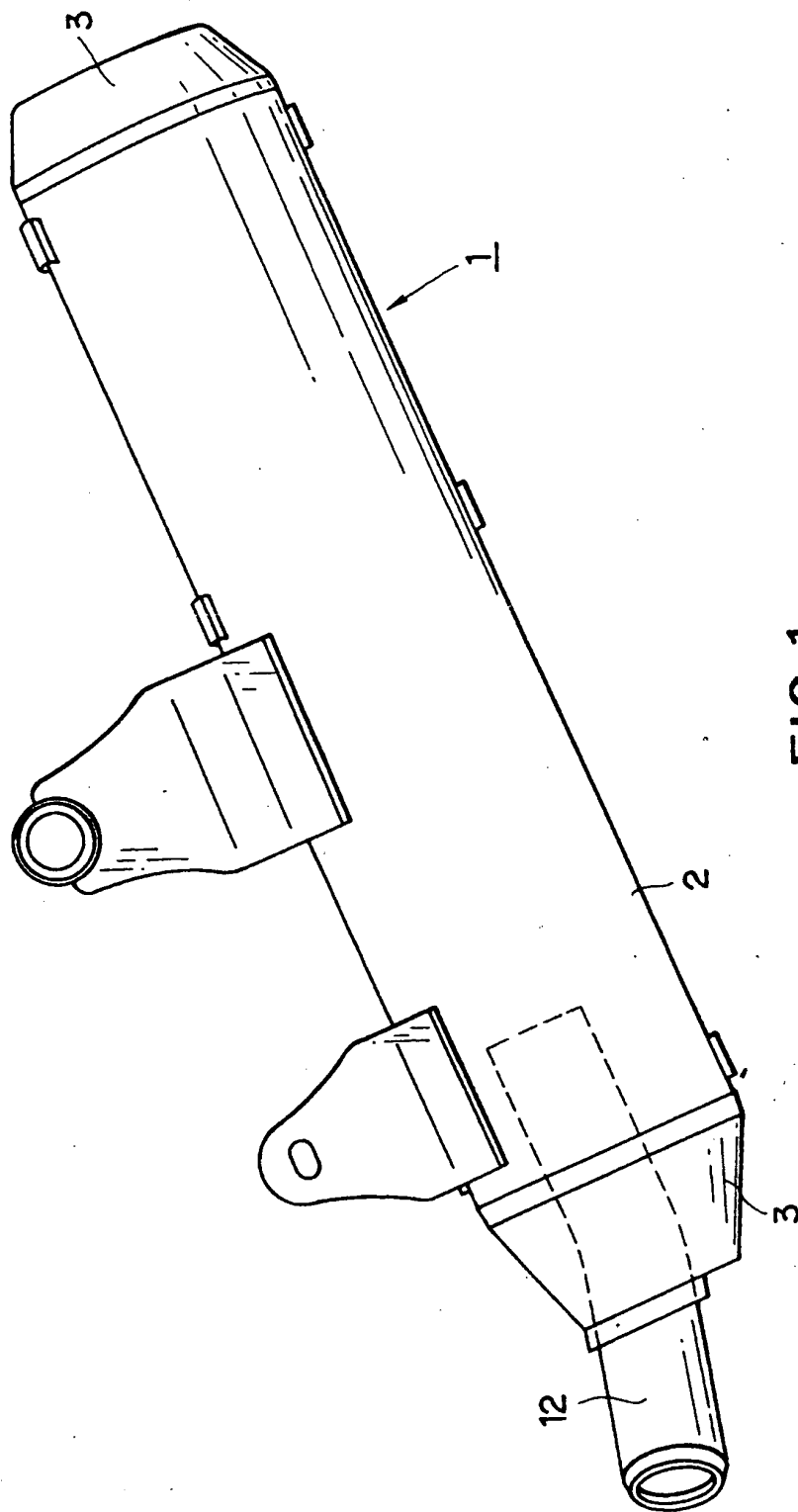


FIG. 1

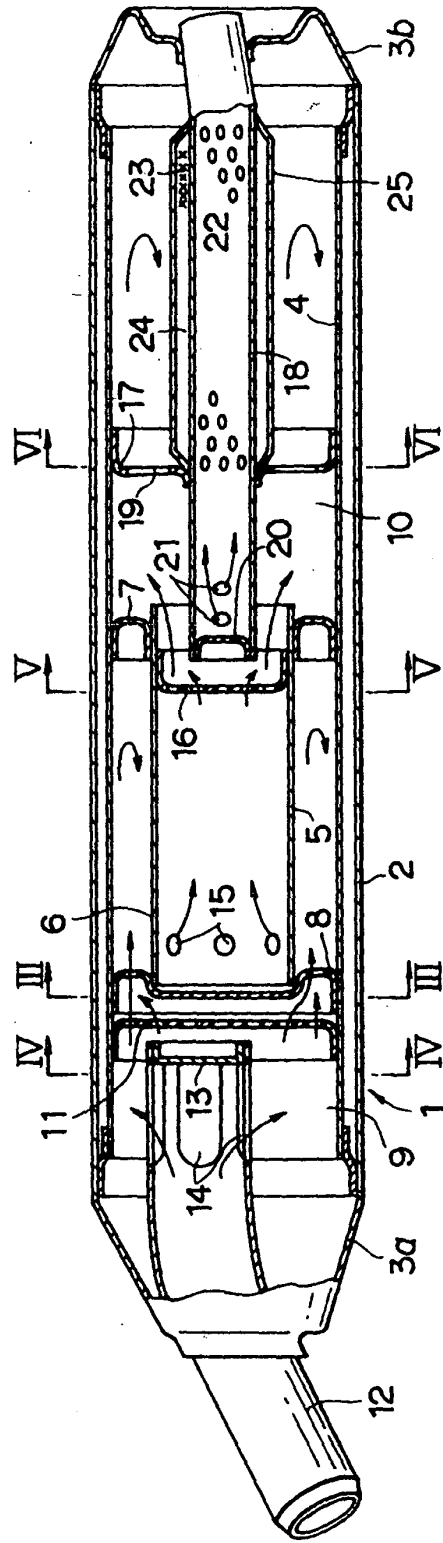


FIG. 2



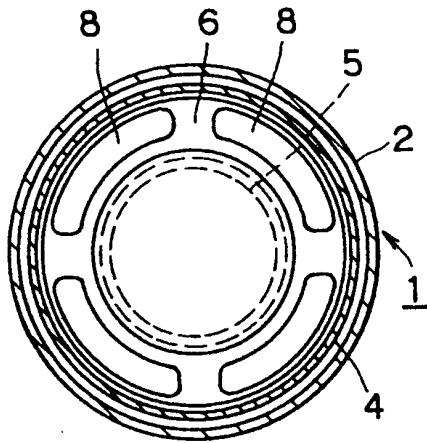


FIG. 3

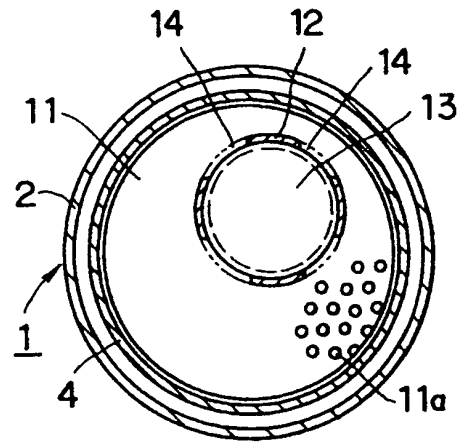


FIG. 4

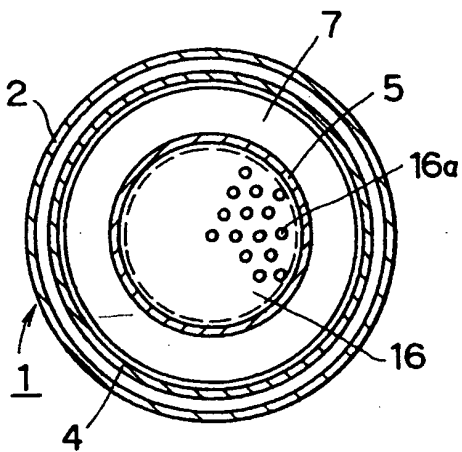


FIG. 5

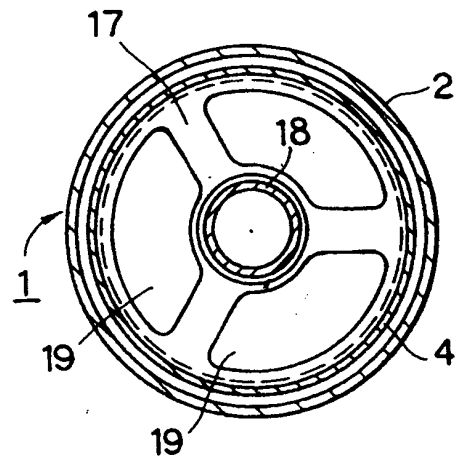


FIG. 6



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## EUROPEAN SEARCH REPORT

Application Number

EP 91 11 5404

### DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	GB-A-2 115 870 (NELSON) - - -	1,2	F 01 N 1/08 F 01 N 1/02
Y	GB-A-2 115 870 (* page 2, line 4 - line 100; figures 1-4 *) - - -	5-8,10-14	
Y	US-A-3 361 227 (KAARI) * column 4, line 27 - column 5, line 66; figures 4-6 ** - - -	5-8,10-14	
A	US-A-2 675 088 (MCLEOD) * column 3, line 34 - column 4, line 11; figures 5,6 ** - - -	4	
A	US-A-4 094 644 (WAGNER) * column 3, line 61 - column 4, line 35 ** - - - - -	9,15	
			TECHNICAL FIELDS + SEARCHED (Int. Cl.5)
			F 01 N
The present search report has been drawn up for all claims			
Place of search	Date of completion of search	Examiner	
The Hague	14 November 91	SIDERIS M.	
CATEGORY OF CITED DOCUMENTS			
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